Uncertainty in Characterizing Vehicle Buyers and Vehicles

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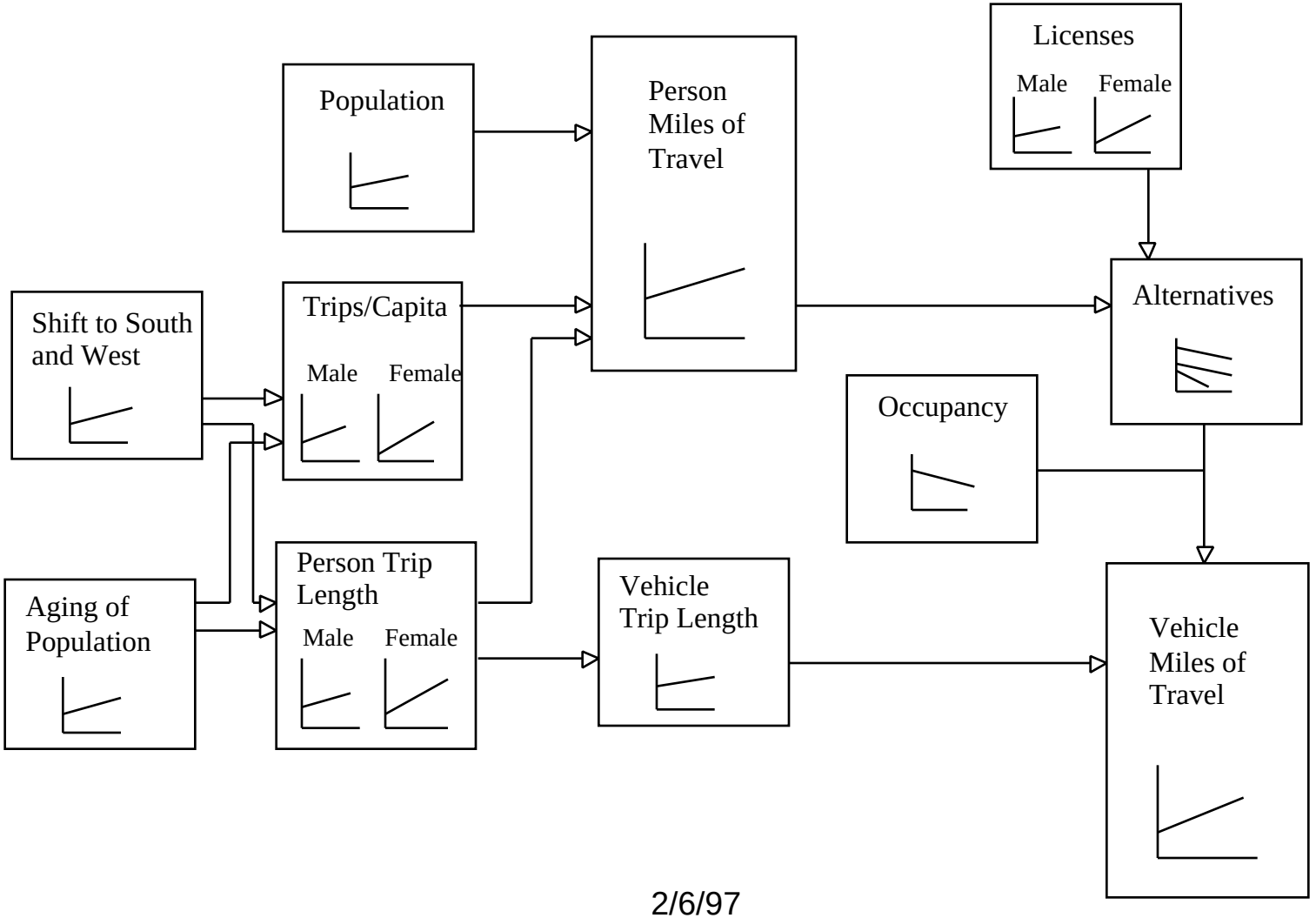
EIA Basecase

	1975	1995	2015
VMT (billion miles)	1328	2375	3174
VMT Growth Rate (percent per year)	NA	2.94%	1.46%
Gasoline Price ($1995)	~$1.50	$1.15	$1.17
Light Vehicle Fuel Economy (MPG)	15.3	19.7	21.3
Light Truck Share (percent)	19%	42%	43%
Transportation Fuel Use (quads)	17.30	24.31	31.99
Highway Fuel Use (quads)	13.77	19.63	24.50

Factors in Growth of Personal Travel



VMT Annual Growth Rates

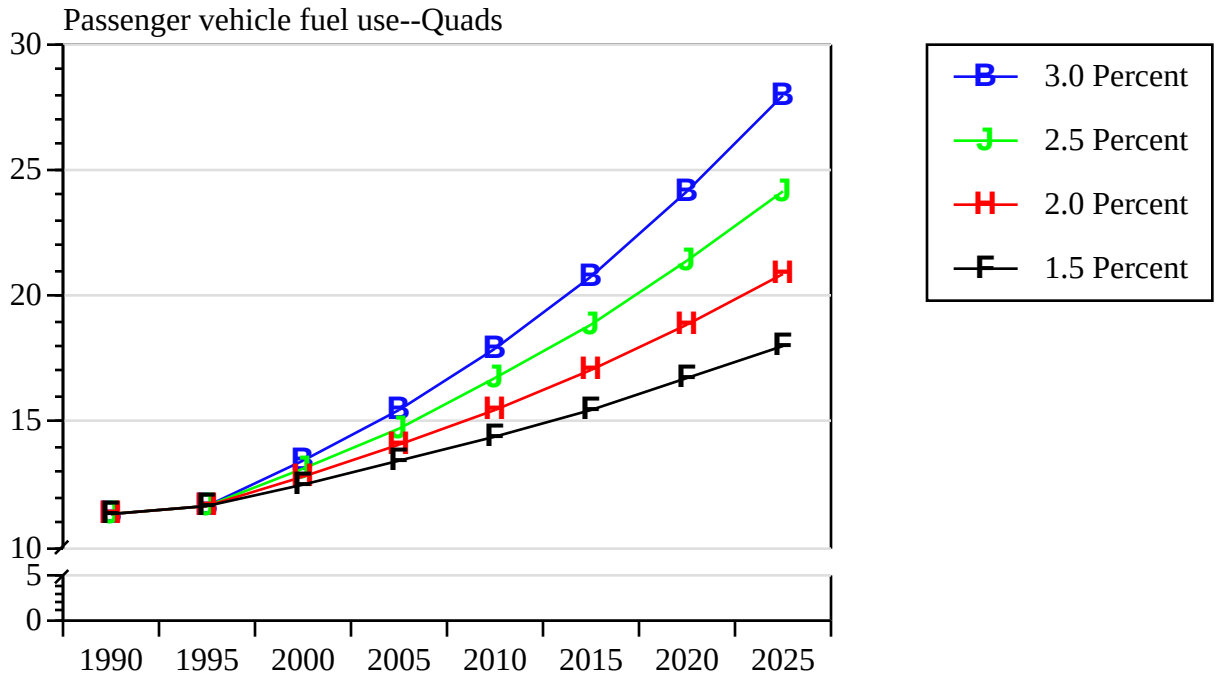
- Historic

Interval	Annual Growth Rate
1970 to 75	3.49%
1975 to 80	2.71%
1980 to 85	3.14%
1985 to 90	3.89%
1990 to 95	2.29%
Trend (70-95)	3.1%

- Projections (1995 to 2015)

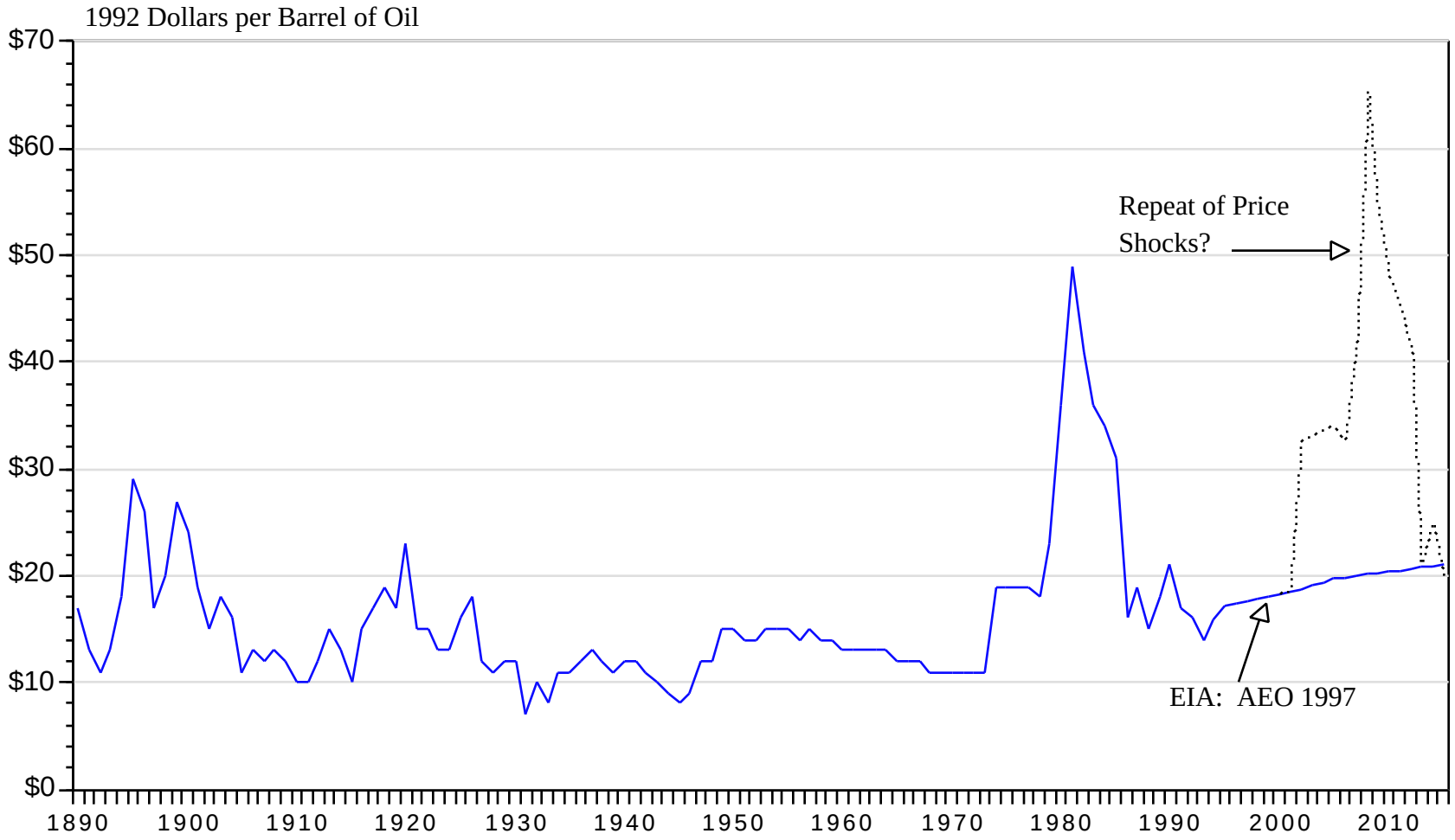
Interval	Annual Growth Rate
EIA/AEO 95	1.8%
EIA/AEO 96	1.4%
EIA/AEO 97	1.4%
DOT/FHWA	2.2% (May 1996)
Cartalk	~1.9%

Uncertainty in VMT Growth Rates Affect Projected Fuel Use



Calculations: based on baseline assumption used in “Car Talk” and constant new car fuel economy.

Uncertainty in Oil Prices



Source: Energy Information Agency (1949-95) and Jenkins, Oil Economists' Handbook (1890-1939).

Baseline

- Fuel economy
  - » Decline (currently happening)
  - » Constant
  - » Grow (EIA)
    - – Cars: increase from 23.2 mpg in 1995 to 27.6 mpg in 2010
    - – Light trucks: increase from 20.4 mpg in 1995 to 23.7 mpg in 2010
- EIA NEMS Horsepower (as 0 to 60 time in second)
  - » Cars: decrease from 10.8 s. in 1995 to 8.4 s. in 2015
  - » Light trucks: decrease from 12.1 s. in 1995 to 11.3 s. in 2015
- Light truck share tops out at 43%

Buyer Groups

- DOE/OTT
  - Households (~95%)
  - Non-HH Use (~5%)
- Lew Fulton: Vehicle Choice Model
  - Two geographic regions
  - Four education/ income classes
- ANL: DVSAM
  - 4 income, 4 age groups
  - 3 regions
  - 4 HH Sizes: 1, 2, 3+
- J.D. Power 1991 System (changed 3 times in 9 years)
  - Epicures (25.9%)
  - Road Haters (25.5%)
  - Gearheads (16.7%)
  - Negatives (15.8%)
  - Functionalists (11.8%)
  - Purists (4.2%)

Buying Trends: Truck Share

	1975	1996	2010 Forecast
Light Truck Share of Light Vehicle Sales (percent)	19%	43%	50%
Resulting Higher Fuel Use Per Interval (Percent)	NA	8.5%	2.3%

Light Truck Share Projections

EIA: Max out at 43%; J.D. Power: Rise to 50% then decline;

DRI: Rise to 48%; Auto Pacific: Rise to 47%.

Buying Trends: Acceleration

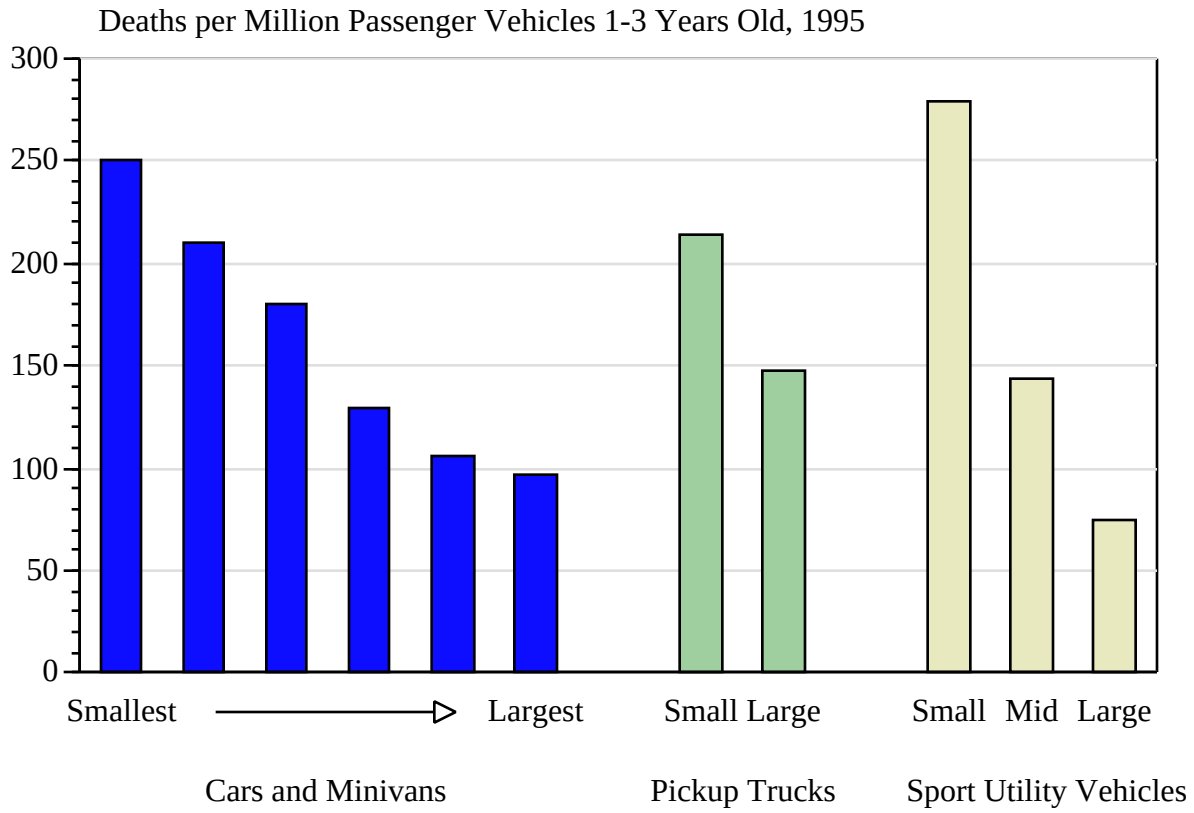
	1975	1996	2010
Acceleration (0 to 60 times in seconds)			
Cars	14.2 s.	10.7 s.	8.5 s.
Light Trucks	13.6 s.	11.6 s.	10.0 s.
Resulting Higher Fuel Use Per Interval (percent)			
Cars	NA	10.5%	8.8%
Light Trucks	NA	11.8%	11.1%

Buying Trends: Weight

- Average weight for cars declined from 4058 pounds in 1975 to 3031 pounds (25%) in 1987 and has steadily grown to 3286 (8.4%) in 1996.

Potential Weight Change (1996 to 2010)	Resulting Fuel Use Change
+ 10%	+ 5.4%
- 10%	- 5.8%
- 20%	- 10.9%
- 30%	- 15.2%
- 40%	- 19.4%

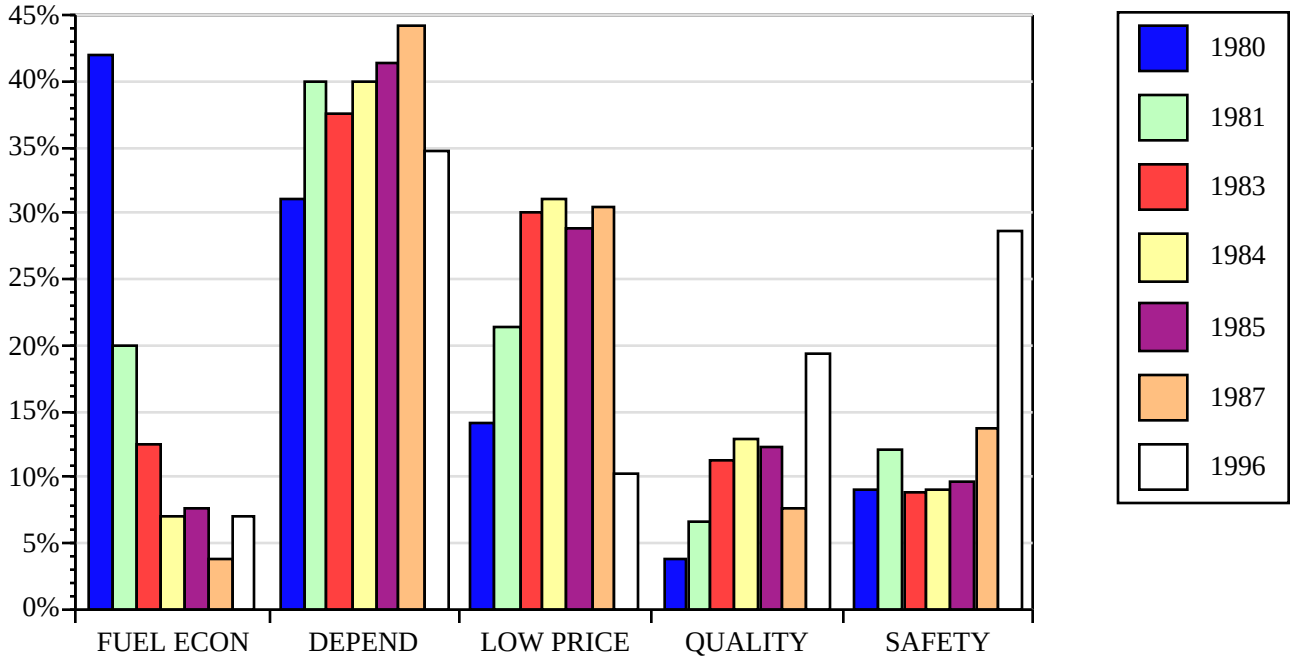
Vehicle Safety



Source: Insurance Institute for Highway Safety, August 1996

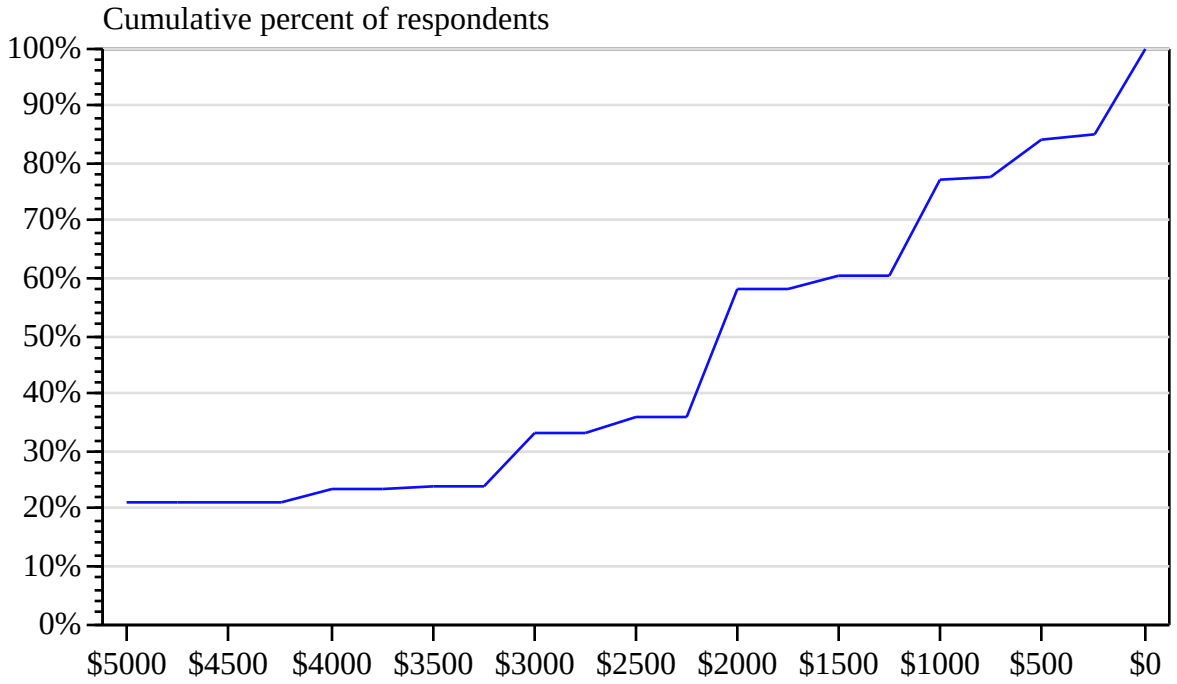
Trends in Attribute Preferences

Most Important Attribute in Next Vehicle Purchase



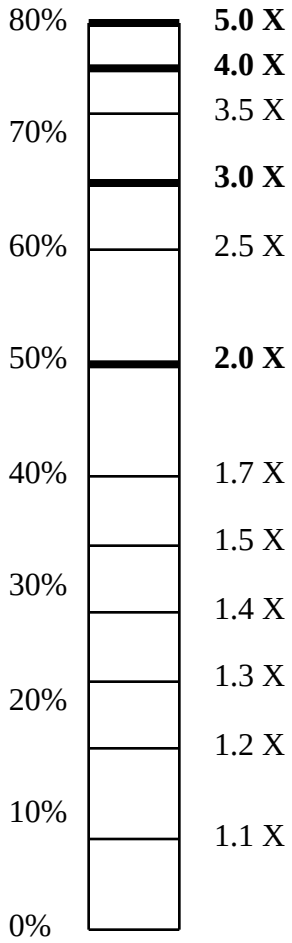
Source: J.D. Power for 1980s data. 1996 data from different survey performed by Opinion Research Corporation for NREL. Data normalized to sum to 100 percent.

Willingness to Pay for Double Fuel Economy



Source: Opinion Research Corporation, "Caravan Study: Fuel Economy," Performed for the National Renewable Energy Laboratory, ORC Study #70542, October 17, 1996. Responses are aggregated at $250 intervals. Non-responses are excluded.

Percent Reduction in Fuel Use Via Increases in MPG



- A 2X Fuel Economy Improvement Achieves 75% of the Savings as a 3X Fuel Economy Improvement
- Beyond 3X, the Fuel Savings Potential is Very Small

Importance of Pollution and Foreign Oil

- Allocate $100 to solve five problems
  - » $18 on reducing pollution
  - » $13 on reducing dependence on foreign oil
  - » $68 on schools, crime, and unemployment

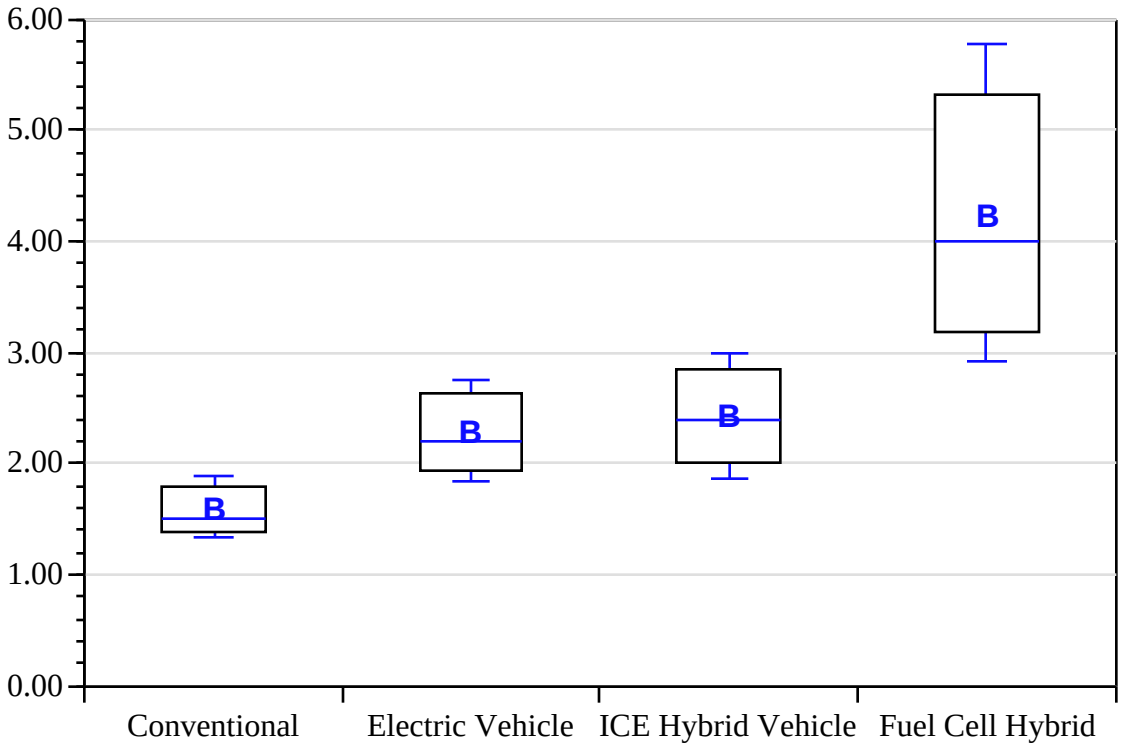
Source: National Coefficient Study, 1996

Technology Introduction

Technology	Small Car		Large Car		Sport Utility Mini Van		Large Truck Large Van	
	Intro	S-curve	Intro	S-curve	Intro	S-curve	Intro	S-curve
Advanced Diesel	2007	3	2007	3	2005	5	2005	5
Flex Alcohol	-	-	1998	3	1999	3	1999	3
Dedicated Alcohol	2005	5	2005	5	2005	5	2005	5
CNG Dedicated	-	-	1998	5	2002	3	1998	5
Electric	1998	5	-	-	1999	5	-	-
Hybrid	2008	3	2005	5	2011	3	-	-
Fuel Cell	-	-	2009	5	2013	3	-	-

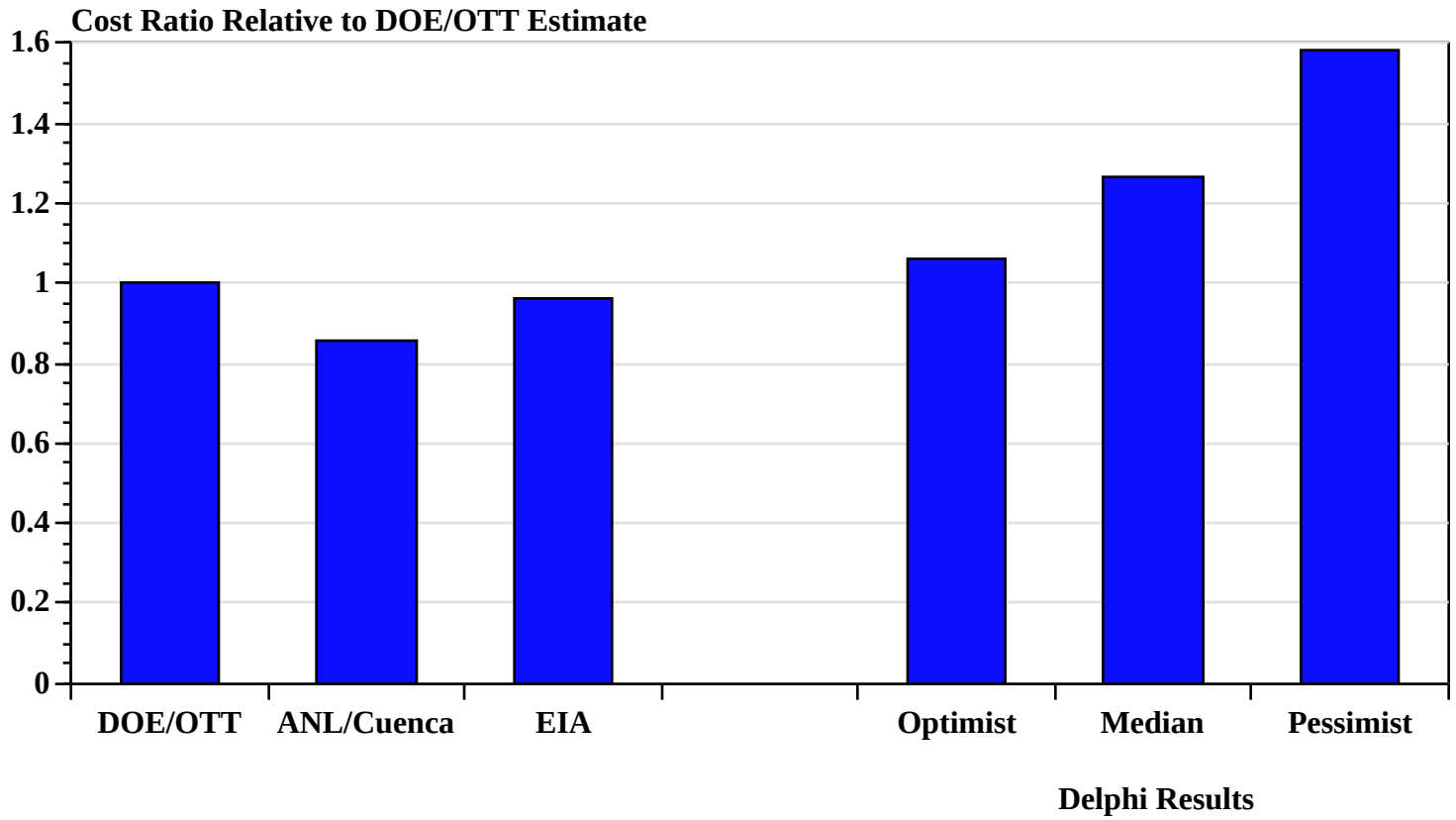
Intro: Year technology is introduced into market
S-curve: Number of years before technology meets full market demand

Electric and Hybrid Delphi: Vehicle Cost Ratios Compared to 1993 Gasoline Vehicle in 2010



Source: Henry K. Ng et al, "The Prospects for Electric and Hybrid Electric Vehicles: Second-Stage Results of a Two-Stage Delphi Study," SAE Technical Paper Series, 961698, August 1996.

Electric Vehicle Cost Ratio Estimates for 2010



DOE/OTT cost ratio estimate is 1.43. Ratio is the cost of an electric vehicle compared to a comparable vehicle of that year.

Average HPU Efficiency Required to Meet Fuel Economy Targets (with Hybrids) vs. Vehicle Mass Reduction

Non-hybrid Diesel ~ 1.3X

Government Actions

- Oil Price and Availability
- Oil Dependency
  - CAFE Standards
  - Alt. Fuel Incentives
  - PNGV Program
- Global Climate Change
  - CAFE Standards
  - BTU Tax
  - Gasoline Tax
  - Biomass Alcohol
- Congestion
  - Intelligent Transportation System
  - Road Pricing
- Ambient Pollution
  - Emissions Standards
  - Inspection & Maint.
  - Transportation Demand Management
- Safety
  - Standards
  - Travel Speeds
  - Traffic Calming

The Potential Impact of Uncertainties

	Reductions
① OTT Estimated Oil Reduction in 2010	X
» 2.8% VMT Growth	1.25 X
» Constant Acceleration	0.90 X
» Weight Increases 10%	1.05 X
» Weight Declines 10%	0.89 X
② EIA Estimated Oil Reductions in 2015	Y
» .5 the Incremental Cost and 1.33 the mpg	3.30 Y